HELP ?

Tightening the supply chain

Production and Inventory Management Journal; Falls Church; Second Quarter 1993; Hammel, Todd R; Kopczak, Laura Rock;

*Duns:***00-912-2532**
Volume: 34
Issue: 2
Start Page: 63
ISSN: 08978336
Subject Terms: Suppliers
Product design
Improvements
Distribution
Computer industry
Case studies
Classification Codes: **9190**: *United States*
9110: *Company specific/case studies*
8651: *Computer industry*
7500: *Product planning & development*
5160: *Transportation management*
Geographic Names: US
Companies: Hewlett Packard Co*Ticker:***HWP***Duns:***00-912-2532**

Abstract:
As the terminals market matured and new, low-cost suppliers entered the market in the 1980s, Hewlett-Packard Terminals Operation (HP) found that its historical competitive advantage - product quality and customer service - was not enough. HP also needed to be competitive with respect to price and availability. Between 1985 and 1991, HP's Terminals Operation made a series of aggressive changes in order to regain its competitive position. It reduced product cost by redesigning the entire product line for improved manufacturability and flexibility. Also, it improved product availability by introducing a new distribution requirements planning process to create a system in which the distribution center pulled product from the factory. As a result, HP was able to announce that it offered the industry's lowest priced, highest quality terminals with off-the-shelf availability, and that the products were made in the US.

Full Text:

Based in Roseville, California, HP's Terminals Operation acts as the worldwide manufacturing site for the Series 700 terminals. It is where HP designs, manufactures, and markets terminals for use with its own line of minicomputers and servers, as well as those offered by other mid-range computer systems vendors.

Hewlett-Packard (HP) remains one of the few top-tier display terminal suppliers with manufacturing operations in the United States. In September of 1992, HP announced they had shipped over two million HP display terminals to customers worldwide with over one million of them being part of the HP Series 700 Display Terminal family currently being manufactured in the U.S. Positioning itself as one of the lowest priced, highest quality terminals in the world with "off-the-shelf" availability and the "Made in the USA" label was no easy task for HP's Terminals Operation.

During the 1980s, HP's Terminals Operation found itself struggling to survive. As the terminals market matured and new, low-cost suppliers entered the market, HP found that its historical competitive

advantage--product quality and customer service--was not enough. HP also needed to be competitive with respect to price and availability. This change in marketing strategy required a corresponding change in manufacturing strategy. HP wanted to develop a manufacturing strategy beyond simply moving operations to the low-cost regions of the Pacific Rim, as rivals Wyse and Digital Computer Equipment Company (DEC) had done. HP challenged itself to develop a strategy which would include maintaining manufacturing operations in the U.S.

Between 1985 and 1991, HP's Terminals Operation made a series of aggressive changes in order to regain its competitive position. This article focuses on two changes it made in that time period. First, HP reduced product cost by redesigning the entire product line for improved manufacturability and flexibility. Second, HP improved product availability by introducing a new distribution requirements planning (DRP) process to create a system in which the distribution center pulled product from the factory.

BACKGROUND--THE FRONTIER PROGRAM

In the mid-1980s, Hewlett-Packard's computer terminals business was rapidly declining. HF's volume of 10,000 units per month was doomed to shrink by 30% within the next two years 6!. HP's terminals were designed to be used exclusively with HP's line of minicomputers. High priced, these terminals were being threatened by cheaper Asian clones and personal computers. Furthermore, HP's minicomputer divisions were reporting customer resistance as terminals were rapidly becoming a larger part of the systems cost.

HP had two alternatives: to implement a plan to become competitive again or to close down production and buy and resell terminals on an original equipment manufacturer (OEM) basis. HP responded by embarking on what became known as the "Frontier Program." The Frontier Program called for a dramatic change in the way HP did business.

TIGHTENING THROUGH PRODUCT DESIGN

HP had been known as a manufacturer of high-quality, albeit high-priced, products. The key to the Frontier Program was to redesign the terminals so they could be manufactured more efficiently and at less cost than the competition, and at the same time, enable manufacturing to respond to customer requirements through enhanced product availability.

Headed by the division's general manager, the Frontier Program's cross-functional project team applied the "design for manufacturability" concept. As industry analyst and writer Jonathan Levine 6! noted in a Business Week article, "The result was a radically new terminal designed for low-cost, high-volume production. It uses 40% fewer parts than previous HP models, and it can be slapped together in hours, vs. days, on an assembly line that produces 1,000 terminals a day."

HP also changed its marketing strategy in order to increase sales volume and subsequently further reduce cost. HP expanded its market by introducing the HP Series 700 terminals products to be used with not only HP proprietary systems, but other vendors' systems, i.e., IBM and DEC.

In order to reduce materials overhead costs, the Frontier team utilized total quality management (TQM) techniques to develop a process which would optimize the materials overhead structure. One of the tools used was the classic fishbone or cause-and-effect diagram (see Figure 1 and Table 1). (Table 1 omitted).

TABLE 1: REDUCED MATERIALS OVERHEAD

FEWER BUT BETTER SUPPLIERS

* Increased purchasing leverage

* Reduced contracting and sourcing time

* Reduced communications requirements

* Facilitates long-term relationships

* Facilitates JIT/kanban programs

* Facilitates continuous improvement

* Shorter/tighter performance feedback

MORE INDUSTRY STANDARD PARTS

* Improved leveraging

* Simplified planning

* Increased buyer familiarity with parts

* Increased use of reliable parts

* Reduced stocking point requirements

* Reduced obsolescence exposure

* Reduced lab effort on designing unique parts

* Reduced stockout probability

* Reduced disc storage requirements

* Reduced manufacturing spec's setup efforts

* Shortened lead times

* Reduced incoming inspection requirements

* Facilitated point of usage stocking

SIMPLE PROCESS DESIGN

* Design packaging for point of usage stocking

* Design storage systems around standard packaging

* Reduced manufacturing cycle time

* More opportunity for computer-integrated manufacturing (CIM) applications

* Bar-coding opportunities

* Reduced requirements for shop floor control (SFC) systems

* Improved opportunity for automation

FLATTER BILLS OF MATERIALS

* Fewer part numbers/suppliers

* Simplified planning processes

* Reduced storage requirements

* Simplified engineering changes

The Frontier team reduced the number of levels in the bills of material, the number of different parts, and number of suppliers as part of the TQM program. In addition, a computer-integrated manufacturing (CIM) system was installed which integrated a variety of minicomputers and microcomputers. These computers handled board testing, auto insertion, and statistical process control (SPC). The core of the system was a closed-loop MRP II system, which included linkages to HP's corporate-wide procurement system, as well as divisional financial and inventory systems. All of these systems and processes were developed to support manufacturing's use of Just-in-Time, kanban and TQM techniques.

TIGHTENING THROUGH IMPROVED PLANNING

Although HP had achieved its major objective of lowering costs, the issue of product availability was becoming increasingly important to customers. HP's marketing strategy emphasized off-the-shelf availability of the world's best-built, lowest-priced terminals. At first the Frontier Program had focused on supply-side issues in order to reduce costs. As HP began to enter new markets (general purpose/IBM compatible/OEM terminals), **forecasting** inaccuracy coupled with increased stockkeeping unit count increased the complexity of the production/distribution system. In order to improve product availability, HP next focused on demand-side issues.

What HP needed was a manufacturing/distribution process which would be in sync with the marketplace. Sometimes termed a market-paced strategy, this strategy strives to schedule manufacturing time as close to development of market demand as possible in order to eliminate the rush of anticipatory inventory 2!. As Hall 5! explains, "the planning for distribution inventory should be on the same planning cycle as the production periods, so production planning always takes place using the freshest possible estimates of need. The ultimate objective is to provide the equivalent of off-the-shelf delivery from production with no finished goods."

Despite the fact that HP was quoting customers off the-shelf availability, performance goals such as high line item fill rate (LIFR) and low back orders were not being met. This was because the planning process did not satisfy customer needs. Although changes in customer requirements came in daily and changes in the assembly build plan were required weekly (or more frequently), the build plan was set only once a month.

Distribution and planning were not well coupled. Once each month the distribution planner sent the master scheduler information on finished-goods inventory (FGI), backlog, and actual orders. The master scheduler would then develop a build plan. Manufacturing would build to that monthly plan without reacting to daily changes in order patterns until the next month. Thus manufacturing would "push" the inventory onto the distribution center (DC), which was located 130 miles away. At the end of the month, the distribution center would report back to manufacturing on FGI, LIFR, and excess inventory.

Although necessary, improvement to the planning process had not yet been made for two main reasons. First, the Frontier Program's initial focus was on supply-side cost-reduction efforts; improvement of product availability was of lower priority. Second, distribution responsibility lay with another HP entity, located in San Jose, California, which was not motivated to improve the distribution process for terminals products. (The San Jose Distribution Center distributed products for a multitude of other product lines. Terminal shipments accounted for a relatively insignificant part of the total revenue shipped from the **remote** facility. Moreover, the distribution center was designed to handle high-volume, low-mix products such as HP's LaserJet printers. Medium-volume, medium-mix terminals products requiring product integration did not meet San Jose's "ideal" characteristics.)

As supply-side issues were resolved, however, demand-side issues began to take on a higher priority.

THE U.S. **SUPPLY CHAIN** BEFORE DRP

The **supply chain** is the network of entities through which materials flow, including suppliers, carriers, manufacturing sites, distribution centers, and customers. The **supply chain** for HP's U.S. organization before implementation of DRP is shown in Figure 2. (Figure 2 omitted) This **supply chain** was duplicated in Europe.

The **supply chain** was a "pull-push-pull" system, with the following characteristics:

* Manufacturing would "pull" raw material from suppliers using JIT techniques.

* Within the plant, manufacturing used "pull" processes to transform materials into finished products.

* Manufacturing would then "push" products onto the distribution center, located 130 miles away.

* Customers would then "pull" products from the distribution center.

The monthly planning cycle did not service weekly (or daily) customer demands. Weekly customer orders did not match **forecasts** loaded into the master production schedule (MPS).

THE U.S. **SUPPLY CHAIN** AFTER DRP

HP needed to synchronize manufacturing output with market demand by physically and systematically linking its distribution activities with its manufacturing activities. To accomplish this, HP converted the existing "pull-push-pull" **supply chain** into a "pull-pull-pull" **supply chain** (see Figure 3). (Figure 3 omitted).

HP built a regional distribution center alongside its regional manufacturing site so that as products flowed off the assembly line they became ready for distribution. The physical linkage improved the overall effectiveness of the organization's operations, as well as improving customer satisfaction. The cycle time

from when units were completed by the factory to when they were ready to meet customer shipments was shortened from days to hours. Other benefits included reduced freight costs, lower in-transit inventories, and reduced administrative efforts to track these inventories and costs.

The new regional distribution center supported only the terminals and personal computer product lines, both of which were medium-volume, medium-mix lines requiring integration and localization at the distribution center. This allowed the organization to design and implement planning and distribution processes (including integration) appropriate to its business needs. This was consistent with trends within HP regarding differentiating distribution centers into two types: those handling higher-mix products requiring integration/customization and those shipping "whole" products with low mix.

Although the physical linkages addressed part of HP's availability problem, the biggest improvement resulted from the implementation of a new planning process featuring DRP.

THE DRP PROCESS

The distribution requirements planning process was the final linkage required to transform the "pull-push-pull" process to a "pull-pull-pull" process. Figure 4 illustrates the new process, which starts with demand management and proceeds through DRP and master production scheduling to procurement planning. (Figure 4 omitted).

A key element in the planning process is the monthly meeting of the manufacturing manager and representatives from manufacturing and distribution to discuss materials and capacity trade-offs and agree on a reasonable build plan.

The DRP computer system runs in the "pull" mode and monitors requirements on a daily or weekly basis. In the former "push" mode, reports on orders, FGI, and backlogs were only generated monthly.

DEMAND MANAGEMENT

The regional marketing groups provide demand data in the form of **forecasts** to the distribution organization. These **forecasts** address such issues as:

* Promotions

* Price changes

* Competitor activity

* Big deals

* Dealer channel demand (industry standard)

* HP's proprietary systems demand and connect rates

* Add-ons for the installed base

* Seasonality and economic conditions

* Stage in product life cycle.

These **forecasts** are loaded into the DRP system, which already has other demand data from order management and supply data from the inventory data bases.

THE PLANNING PROCESS

A distribution planner then begins the net requirements planning (NRP) process by netting demand such as backlog (existing customer orders) and **forecasts** against FGI and supply orders. The result projects supply requirements over a time-phased 12-month horizon.

The NRP is communicated to the master scheduler, who then creates the MPS for input into the MRP II system. In theory the NRP should match the MPS. The MPS drives the procurement plan. In addition to driving the monthly planning process, the distribution planner also drives the weekly planning process which is used to micro-manage production within the coming two-week window. The weekly plans reflect the latest information on actual customer orders. Under the new "pull" system:

* Trends in demand are monitored more closely.

* Key supply and demand information for the next two weeks is developed each Monday.

* Build plans are changed to meet customer needs on a weekly basis.

* The distribution planner is allowed to change the mix but not the production rate on a weekly basis.

Frequent changes in the mix require a very flexible manufacturing organization; the Frontier Program provided that flexibility. Commonality of parts, flexible lower-level inventory strategies, versatile people and processes, coupled with a shortened information cycle has allowed the manufacturing team to quickly respond to the changes in the mix requirements in today's marketplace. This has resulted in substantial improvements in the line item fill rate.

LINE ITEM FILL RATE IMPROVEMENT

While the Frontier Program yielded great cost-reduction results, it wasn't until DRP was implemented that HP improved the availability of product. Line item fill rate, order turnaround time, backorders, and weeks of supply are the measures of success. With the implementation of the DRP system, HP began to realize immediate improvements in all of these measures. Moreover, HP was able to realize continued improvements while reducing FGI by 60%. Figure 5 shows the reported LIFR during this period. (Figure 5 omitted).

HP looks at LIFR data for the previous 30 days and for the previous 90 days. LIFR is calculated as the total number of customer order line items filled divided by the total number of customer order line items attempted (each time HP tries to pull a line item, it is counted as an attempt).

HP implemented the DRP system in July 1990. As shown in Figure 5, the LIFR improved from below 90% in July 1990 to over 98% in May 1991. (Note: The dip in LIFR in January was due to the combination of a **forecasting** error and the plant having been closed down for Christmas week, making response difficult.)

CONCLUSION

By mid-1990, HP had effectively addressed its problems related to cost effectiveness and product availability. The redesign of the terminals products and expansion of the product line has led to increased sales volume and improved manufacturability, resulting in substantial reduction in materials and manufacturing overhead costs.

The linkage of distribution and manufacturing both physically and systematically, coupled with the implementation of the demand pull DRP system enhanced HP's product availability. Improved performance has translated into higher product line profitability.

Moreover, HP has been able to keep manufacturing and warranty costs in check vis-a-vis an unwavering commitment to quality. In September of 1992, HP announced that the HP Series 700 display terminals demonstrated a mean time between failure (MTBF) of up to five times greater than that being quoted by its leading competitors. HP's Terminals manufacturing and engineering team stated that "this breakthrough in MTBF is a tribute to HP's strategy of manufacturing terminals in the United States instead of in Taiwan."

HP realizes, however, that the life of the terminals product line is limited. HP must continually review its decision to remain in the market and look for opportunities to further reduce cost and improve availability. Only in this way can HP continue to remain successful in this extremely competitive market.

ACKNOWLEDGMENT

The authors would like to express thanks to Dr. Hau Lee of Stanford University and to Lee Wiese and Jan Bell of Hewlett-Packard for feedback on earlier versions of this paper.

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